THE INCIDENCE OF *ICHTHYOPHTHIRIUS MULTIFILIIS* FOUQUET 1876 IN FISH FROM TWO FRESHWATER STREAMS AND COMMERCIAL BAIT SHOPS OF ROWAN COUNTY, KENTUCKY

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ABSTRACT OF THESIS

THE INCIDENCE OF ICHTHYOPHTHIRIUS MULTIFILIIS FOUQUET 1876 IN FISH FROM TWO FRESHWATER STREAMS AND COMMERCIAL BAIT SHOPS OF ROWAN COUNTY, KENTUCKY

Ichthyophthiriasis, caused by the ectoparasitic ciliate Ichthyophthirius multifiliis, is one of the most serious diseases of freshwater fish. Very few studies have been done on the incidence of this parasite in wild fish populations. This study was concerned with the incidence of this parasite in Triplett Creek and the North Fork of Triplett Creek of Rowan County, Kentucky. Four collecting stations were established on each stream. Fish were obtained by trap or seine and observed under a dissection microscope for the identification of the disease. Five hundred forty-seven fish were examined from Triplett Creek, 59 of which were found to be infected with Ichthyophthirius. Five hundred nineteen fish were examined from the North Fork of Triplett Creek, 17 of which were infected with the parasite. Examination of bait minnows from local shops revealed a high incidence of infection with the parasite. The possible increase in incidence of Ichthyophthirius in the wild fish population as a result of the use of infected bait minnows is pointed out in this study.

Lois Irene Parsons

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Date

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INTRODUCTION

Ichthyophthirius multifiliis is an ectoparasitic ciliate of fish which is responsible for large numbers of fish kills in hatcheries, farm ponds, and aquaria, but its contribution to fish mortality in the wild has not been determined.

The author became interested in the distribution of Ichthyophthirius multifiliis when it was discovered that one hundred fathead minnows purchased from a local bait shop showed a high incidence of infection with the parasite. It was the intention of the author at the time of that purchase to obtain healthy minnows for a growth and fecundity study. Because of increase in interest and the recognition of the importance of research concerned with the adverse effects upon the wild fish population as a result of the sale of bait minnows infected with Ichthyophthirius, the author decided to investigate the incidence of the parasite in Triplett Creek and the North Fork of Triplett Creek, Rowan County, Kentucky (Figure 1). The author also determined to investigate the incidence of the parasite in minnows sold as bait in Rowan County, Kentucky.

Fish belonging to the families Cyprinidae, Percidae, Catastomidae, and Centrarchidae were taken from Triplett Creek and the North Fork of Triplett Creek and examined for the presence of Ichthyophthirius. Bait minnows, obtained from shops in Rowan County and examined for the presence of

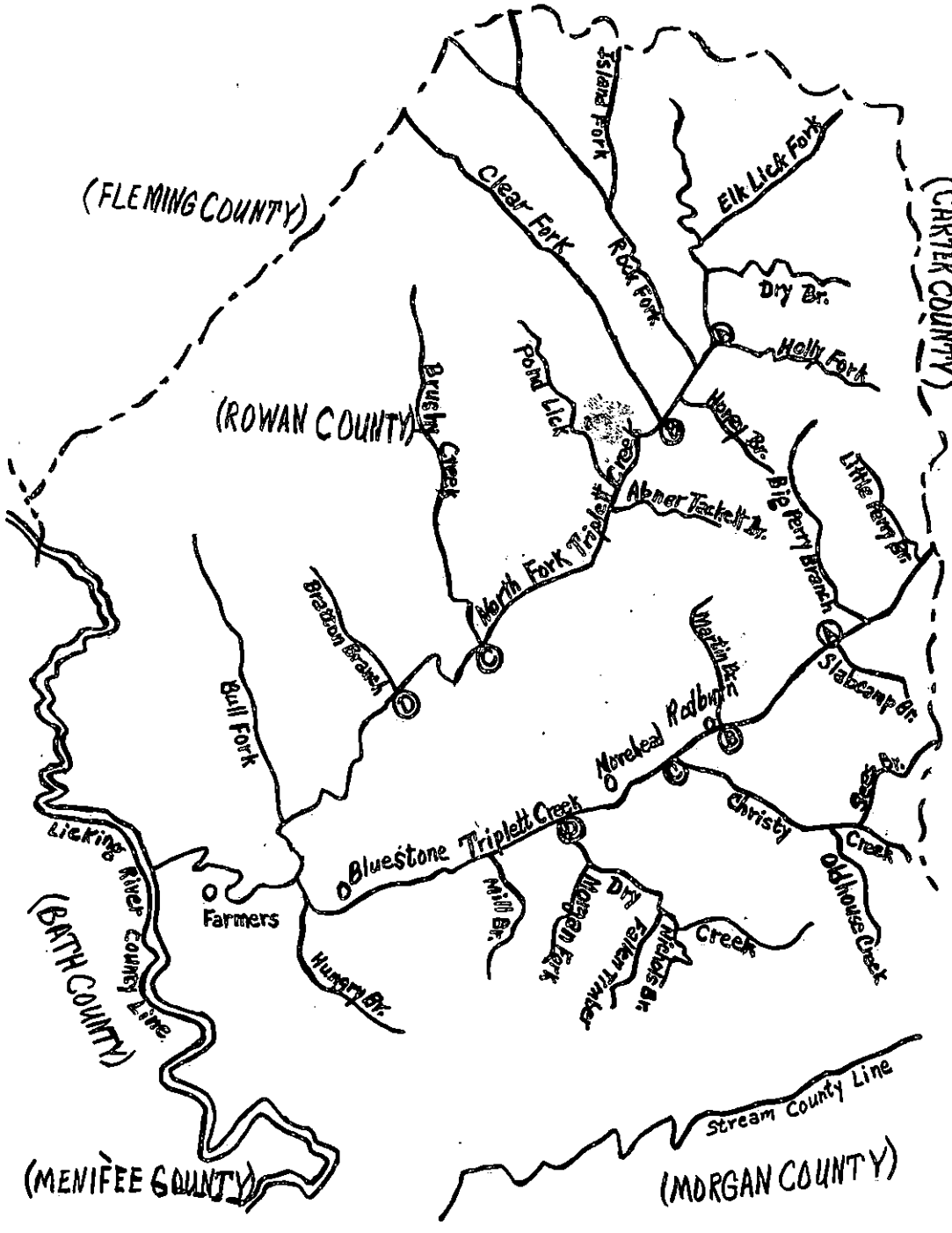


Figure 1. Drainage system of Licking River, Rowan County portion, showing specific collecting sites (A, B, C, D).

the parasite, were Pimephales promelas (fathead minnows).

It is intended that this study will provide significant information concerning the extent to which this parasite is distributed in the wild and that the results of this study will contribute to the prevention of the spread of this serious disease through the sale and dissemination of infected bait minnows.

REVIEW OF THE LITERATURE

Ichthyophthirius multifiliis Fouquet, an ectoparasitic ciliate of fish, was first described in France (1876), but its origin is not known. It has been found in all parts of Europe, North America, China, India, Indonesia, and Australia. According to Hoffman (10), it is probable that Ichthyophthirius multifiliis is now present in every country which has engaged in foreign fish exchange.

Ichthyophthirius also occurs in brackish waters and in the sea. It has been found on the puffer fish and on several species of sea bream in the Adriatic and the Mediterranean. It has also been found on mackerel.

Duijn (8) reports that Ichthyophthirius was not found in the wild in England until 1960. Ichthyophthirius is endemic in free waters of Europe and the United States. Although the parasite does occur in Russia, it is found only in areas south of 60 or 65° north latitude.

Hoffman (10) describes the parasite as oval to round but very plastic, varying in diameter from 50 microns to 1 millimeter. The cytostome is very difficult to see in larger specimens. The horseshoe-shaped macronucleus, with the micronucleus adhering to it, can be seen in unstained preparations.

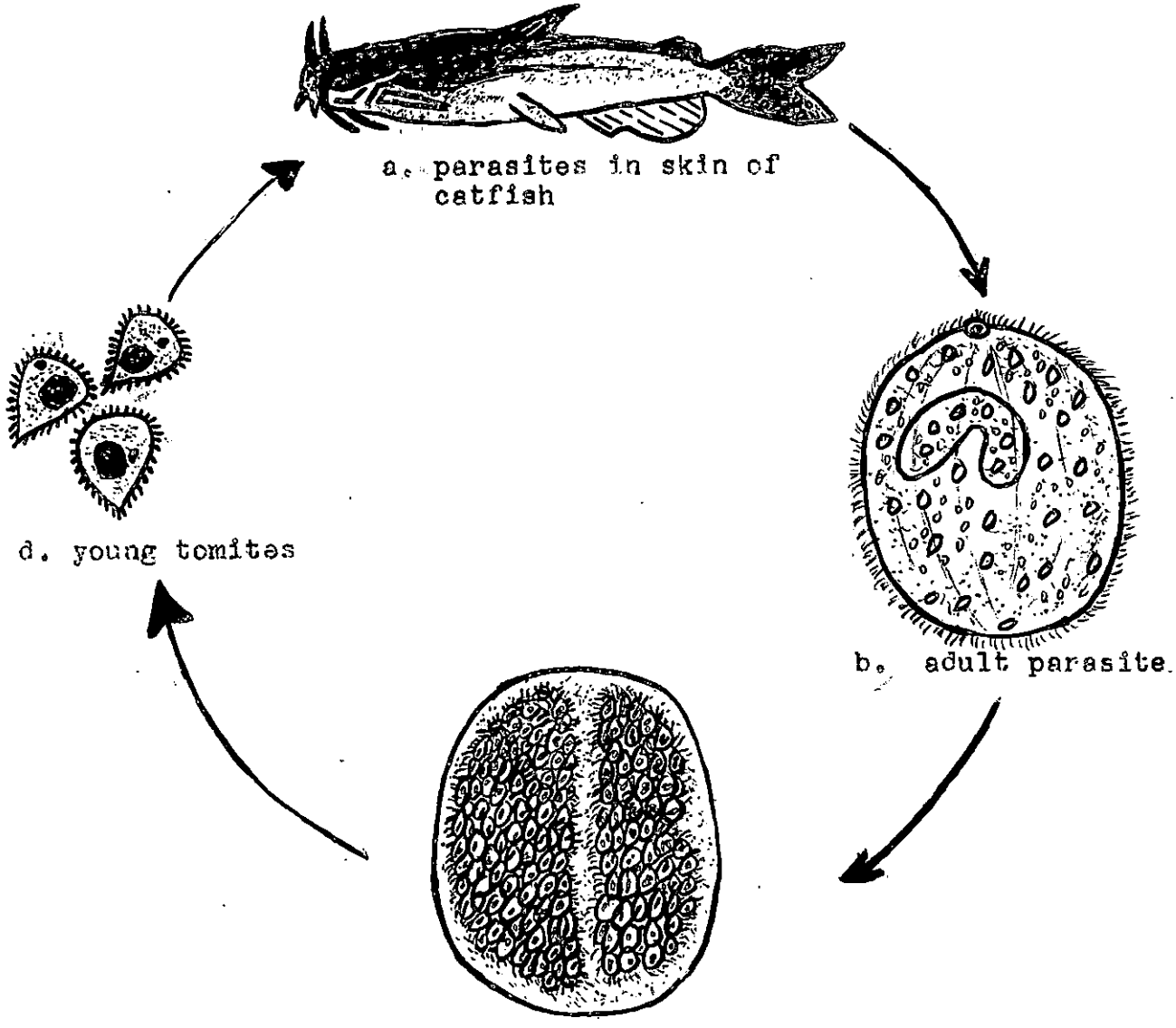
The parasite can be found easily by scraping material from the surface of the body of the fish and examining the preparation in water under low magnification. The protozoan

can be distinguished with the naked eye as a minute, rounded white body, slowly swimming through the medium.

Davis (7) describes the complicated life history of Ichthyophthirius (Figure 2), thus: The young parasite is very small and in appearance entirely different from the adult. It swims about actively in search of a host, and when it comes in contact with a fish, it bores into the epidermis, attaches itself by one end of the cone-shaped body, and rotates rapidly, so that it quickly displaces some of the epithelial cells. In this manner the parasite gradually works its way into the deeper layers of the epidermis, destroying the cells in its path. Wolf (16) finds that in trout the parasite eventually comes to rest between the epidermis and the cutis. Davis (7) states that, as a result of the irritation caused by the boring of the parasite into the tissues, there is a rapid proliferation of epidermal cells; and in the gills where there is little connective tissue, the parasite frequently appears to be surrounded entirely by the greatly thickened epithelium.

According to MacLennan (11), once embedded in the skin of the host, the parasite begins to grow rapidly. It soon appears to the naked eye as a small white spot or swelling. When full grown, the parasite leaves the fish and drops to the substratum, where it soon forms a cyst by secreting a thin membrane around itself. Within the cyst, the parasite multiplies rapidly by division, and, eventually, a large number of minute young are produced. According to Duijn (8),

Figure 2. Life cycle of *Ichthyophthirius multifiliis* [redrawn from Davis (1967)]



from 500 - 1200 young parasites may be produced from one adult. When reproduction is completed, the cyst wall breaks open, and the young swim off in search of a host.

In fish hatcheries, where over-crowding frequently exists, Ichthyophthirius is a serious problem. Butcher (6) reports heavy losses among trout and salmon of all ages.

Davis (7) finds that very few freshwater fish are immune to infection with Ichthyophthirius, although some species are much more susceptible than others. Catfishes, sunfishes, carp, and goldfish are especially susceptible. In the northern states, smallmouth and largemouth bass in hatchery ponds sometimes become heavily infected in late winter and early spring.

Putz of the Hoffman (10) Laboratory in Kearneysville, West Virginia, has noted that newly hatched bluegill fry are resistant to Ichthyophthirius.

Bauer (3) observed that death of the fish usually occurs during the growth period of the parasite when much damage is produced by the large, active trophozoite. He found that in severe infections the epithelium sloughs off and the fish succumb quickly. In 1959, Bauer (3) noted that previously infected fish retain partial immunity for several months.

Many methods of treating ichthyophthiriasis have been recommended. Usually only the free-swimming parasites are killed, since it is difficult for chemicals to be effective against the trophozoite under the skin. Avdos'ev (2), in 1962, reported that the trophozoites taken from the skin of

carp treated with malachite green did not produce infective tomites.

Hoffman (10) has found the most reliable methods of treatment to be as follows: (a) formaldehyde 1:5000 for one hour at 0 to 18° C, 1:6000 at warmer temperatures used daily, (b) formaldehyde 15 to 25 ppm daily in aquaria and ponds, (c) malachite green 2 ppm for half an hour daily or 0.1 ppm in ponds and aquaria, (d) methylene blue 3 ppm in ponds and aquaria. If the water is polluted, higher concentrations are recommended.

Duijn (8) has found that quinine salts (3:100,000) will kill all young parasites and cysts without having bad effects on adult fishes.

Some antibiotics have been found to be effective against Ichthyophthirius, even when it is in the skin of the fish. Penicillin in a concentration of 40,000 I. U./100 l is said to clear the condition in six hours. Duijn (8) does not recommend the use of penicillin because of the probability of producing resistant strains of bacteria as a result of this method of treatment.

In 1937, Buschkiel (5) suggested a four to eight week quarantine of fish before they are introduced into an uninfected pond or aquarium. Fishing equipment and water plants may also serve as a means of introducing Ichthyophthirius into an uninfected pond.

Butcher (6), in 1942, reported outbreaks of ichthyophthiriasis in the Ballarat Fish Hatchery, with losses for two

seasons totalling 450,000 brown and rainbow trout. The source of the infection was from carp introduced into the hatchery.

In 1968, Hlond (9) successfully cultivated young stages of Ichthyophthirius in sterile media containing dessicated, fresh mucus taken from the body surface of carps at 0.3g per 100 ml filtered tap water.

Studies conducted by Tesch (14) in 1968, involving the exposure of Ichthyophthirius to different salinity levels, revealed that the parasite could survive from two to four weeks on young eels in an 8, 15, and 30 per cent saline solution (compared to the average 3 per cent saline of marine conditions) at 15° C. After exposure to high salinity, the parasite was not affected beneath the epidermis, but the cysts and young free-swimming forms could no longer cause infection.

One of the most complete studies concerning the natural history of Ichthyophthirius was conducted by Parker (12) at the University of Maryland in 1965. Parker reared parasite-free goldfish in the laboratory. He then infected them with Ichthyophthirius by way of a single encysted mature parasite, obtained from a naturally infected goldfish.

Parker observed that the mature parasite after being freed from the host swam freely for a short period of time. After two to four hours 90 per cent of the parasites were encysted. Ninety-one per cent of the ciliates, which had been parasitic on fish for three to six days, underwent successful encystment and reproduction. The time required for reproduction within the cyst ranged from nine to thirteen hours,

with 88 per cent completing their division in nine to eleven hours. Cellular division was consistent through at least the sixteen-cell stage, with division occurring approximately at one hour intervals. After release from the host, the total time required for the completion of excystment was related to the size of the cyst and, therefore, to the size of the mature parasite. The mean number of ciliates produced increased geometrically as the size of the cyst increased. The largest cysts observed, 0.35 mm in diameter, produced a mean 732 parasites per cyst. Following excystment, the infective stage ciliates were free-swimming for a short period of time, but their life span did not exceed thirty hours. Their infectivity for fish decreased rapidly from 34.2 per cent two hours after excystment to 1.2 per cent after twenty hours. Parker disagrees with the report of Duijn (8) concerning the division of the mature parasite by binary fission before encystment when the amount of oxygen is reduced. Parker has observed binary fission only in the encysted stage. He found that the period of host infection lasted a minimum of two days and up to approximately six days with most parasites leaving the fish after four to five days of infection. The complete cycle of infection was found to vary from two and one-half to seven and one-half days.

Parker also found the lethal dose of infective stage parasites for goldfish, 3 cm to 5 cm total length, to be 108 parasites per fish when conditions were provided enabling cycling of the parasite and reinfection of the fish. Doses

greater than 500 parasites per fish always resulted in death of the host. Immunity of fish recovered from a primary infection of less than 100 parasites was reported. Immunity was found to be effective for periods up to two months following initial infection and recovery. The humoral origin of the immunological response was evaluated by immunizing fish with killed parasite antigen. The artificially immunized fish were twice as resistant to infection as were primary infected controls. Parker states that an immune mechanism, possibly of humoral origin, plays an important role in protecting fish against reinfection.

Wellborn (15) reports having observed a light infestation of Ichthyophthirius on fish collected from Elkhorn Creek, Kentucky (approximately ten miles north of Frankfort on Highway 127). He also reports seeing the parasite on fish collected from streams in Arkansas, Louisiana, Mississippi, Alabama, Tennessee, North Carolina, and South Carolina.

The only epizootic of Ichthyophthirius multifiliis in a wild fish population was reported by Allison and Kelly (1) in March 1962. Thousands of dead shad were collected from a two-hundred-mile portion of the Coosa River, a slow-moving stream with several impoundments, in Alabama.

MATERIALS AND METHODS

Triplett Creek, having its headwaters on the western boundary of the Carter County watershed, flows westward into the Licking River near Farmers, Kentucky (Figure 1). The banks and water of Triplett Creek, observed during the collection of data for this study, were found to be heavily polluted with debris. Several sawmills also contribute to polluting the water by emptying large amounts of sawdust into the stream.

Four collecting stations, similar in ecology, were established on Triplett Creek. The depth of the water was not more than four feet at any of the sites. All the stations were located near the junction of a small branch and Triplett Creek. The water in these areas was usually very still and contained large fish populations. This made trapping and seining less difficult.

The North Fork of Triplett Creek, having its headwaters near the Lewis County watershed, flows southwestward through the northeast section of Rowan County. The North Fork of Triplett flows through a valley north of Morehead and joins Triplett a few miles west of Bluestone, Kentucky. Because the North Fork of Triplett is not as heavily populated as is Triplett, much less pollution was observed on its banks and in its waters.

Four stations, which were very similar in depth and

ecology to those on Triplett Creek, were established on the North Fork of Triplett. The water at these stations did not exceed three feet in depth.

Collection sites on both streams were selected on the basis of accessibility and suitability for trapping. The author, unsuccessful in trapping swift and deep waters, had more success in areas where small branches joined the larger streams.

Fish examined for the presence of Ichthyophthirius multifiliis from both streams were taken by means of minnow trap or by seine. Trapping was done primarily in the cold weather of March. Seining was employed in the latter part of April.

The fish examined for this study ranged in length from 40 to 120 mm. Since no species of fish is immune to Ichthyophthirius, various species were examined during this study (Table 1).

Examination involved placing each fish in a small dish under a dissection microscope (2X magnification) to determine whether Ichthyophthirius was present. If any small white organisms were observed on the body, further clarification was made by scraping a small amount of material from the fish's body and examining it under higher magnification (100X).

When a heavily infected fish host was observed, Beckert's method (4) of examination for Ichthyophthirius was employed. The fish was pithed and placed in a petri dish filled with dechlorinated tap water. After the death of the host, the parasites left the fish and swam about freely in the water.

Beckert's method was especially effective for obtaining adult Ichthyophthirius (Plate 1) for slides.

Fish not heavily infected with Ichthyophthirius were placed in large aquaria (55 gallons) for further observation of the effect of the parasite on the host. Those fish free of infection with Ichthyophthirius were released in the Pine View Fishing Lake, which is no longer used for fishing. Any uninfected fish caught at a station where infected fish were also found were not released but used in the laboratory observation.

A study of bait minnows from local shops was made by employing the same methods designed for studying wild fish. The owners of both fishing lakes, which supplied the bait species, were cooperative with the author in describing the fish mortalities which had occurred in their lakes.

Table 1. List of species examined indicating scientific and common name.

Family Cyprinidae	
Notropis cornutus	common shiner
Notropis rubellus	rosyface shiner
Notropis umbratilis	redfin shiner
Pimephales notatus	bluntnose minnow
Semotilus atromaculatus	creek chub
Ericymba buccata	silverjaw minnow
Family Centrarchidae	
Lepomis macrochirus	bluegill
Ambloplites rupestris	rock bass
Family Percidae	
Etheostoma caeruleum	rainbow darter
Etheostoma blennioides	greenside darter
Family Catastomidae	
Hypentelium nigricans	hog sucker

RESULTS

TRIPLETT CREEK

Station A.

Thirty-three of the 164 fish taken from this station were infected with Ichthyophthirius. These data show a 20 per cent incidence of ichthyophthiriasis. Members of the genus Notropis taken from this area were also heavily parasitized by glochidia larvae.

Station B.

Twenty-six of 106 fish examined from this station were infected with Ichthyophthirius. This represents a 24 per cent incidence of infection. Actually, at this station fish were taken from two adjacent areas: one, a stagnant pool of water in which infected fish were found; the other, a free-flowing area from which uninfected fish were taken (Figure 3). Members of the genera Notropis and Semotilus were heavily parasitized by glochidia larvae.

Station C.

From this station 137 fish were taken and examined; none were infected with Ichthyophthirius. Members of the genera Notropis and Semotilus were heavily parasitized by glochidia larvae.

Station D.

One hundred forty fish taken from this station were examined; none were infected with Ichthyophthirius. Members of the genera Notropis and Pimephales were heavily parasitized by glochidia larvae. Members of the genera Lepomis, Ericymba, Etheostoma, and Hypentelium were not heavily parasitized by glochidia larvae.

Figure 3. Showing configuration of Station B where Hwy. 32 bridge crosses Triplett Creek.

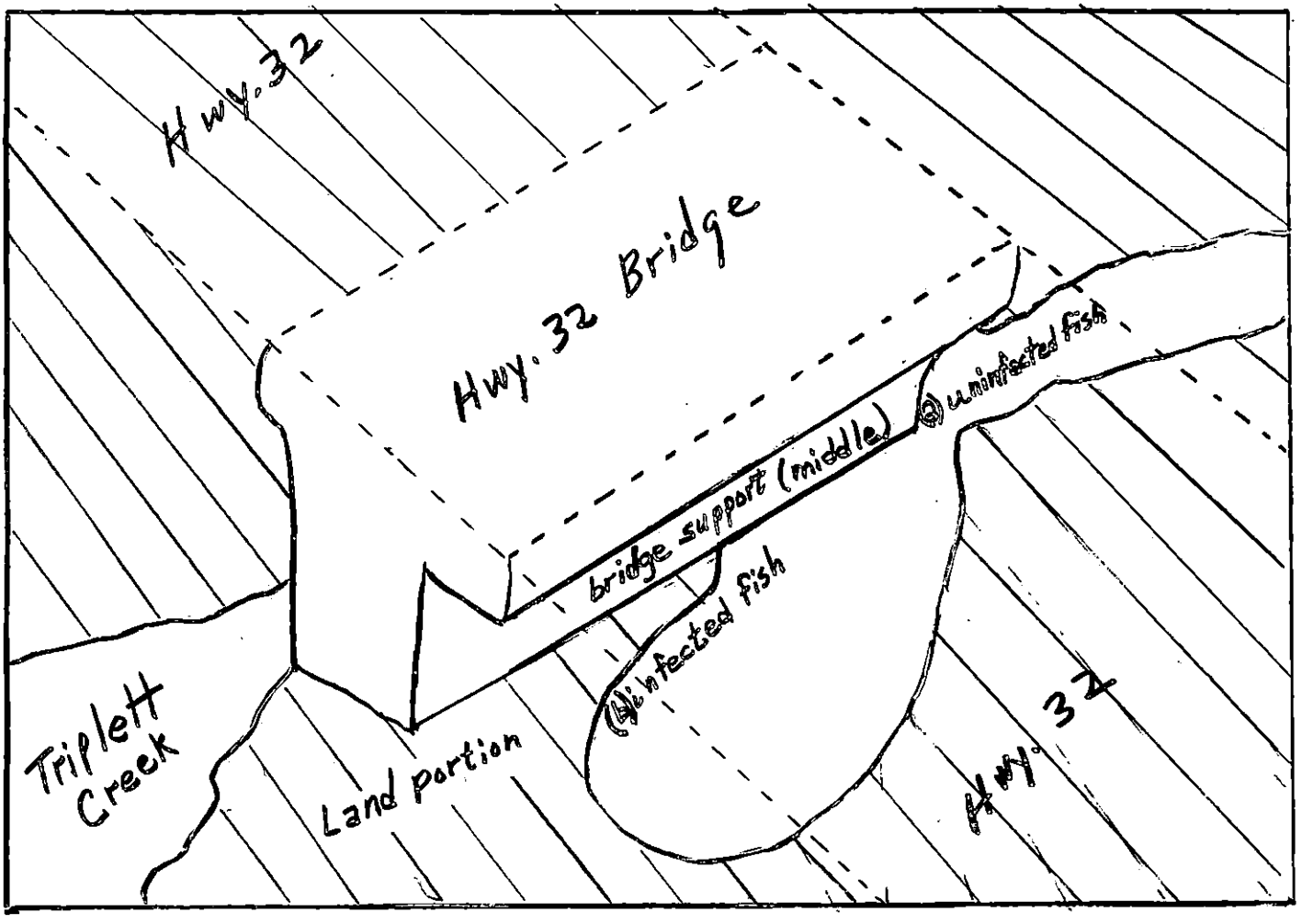


Table 2. Collection data from Triplett Creek, Station A.

Date	Genus Name of Fish	Number Examined	Number Infected with "Ich"	Depth of Water (ft.)	Temp. of Water (C^{o})
March 21	Ambloplites	14	0	1-3	12 C
	Notropis	69	16		
	Lepomis	16	4		
March 25	Ambloplites	10	2	1-3	12 C
	Notropis	22	4		
April 16	Ambloplites	8	0	1-3	14 C
	Notropis	16	5		
	Lepomis	9	2		
TOTALS:		164	33		

Table 3. Collection data from Triplett Creek, Station B.

Date	Genus Name of Fish	Number Examined	Number Infected with "Ich"	Depth of Water (ft.)	Temp. of Water (C°)
March 12	Ambloplites	10	10	1-4	10 C
March 14	Notropis	20	0	1-3	10 C
	Semotilus	8	0		
April 16	Notropis	20	0	1-3	16 C
	Semotilus	15	0		
April 18	Ambloplites	13	7	1-4	17 C
	Notropis	20	9		
TOTALS:		106	26		

Table 4. Collection data from Triplett Creek, Station C.

Date	Genus Name of Fish	Number Examined	Number Infected with "Ich"	Depth of Water (ft.)	Temp. of Water (C^{o})
March 17	Notropis	41	0	1-3	11 C
	Semotilus	13	0		
March 21	Lepomis	13	0	1-3	12 C
	Notropis	19	0		
March 25	Lepomis	7	0	1-3	12 C
	Notropis	16	0		
April 17	Lepomis	5	0	1-3	16 C
	Semotilus	6	0		
	Notropis	17	0		
TOTALS:		137	0		

Table 5. Collection data from Triplett Creek, Station D.

Date	Genus Name of Fish	Number Examined	Number Infected with "Ich"	Depth of Water (ft.)	Temp. of Water (C°)
March 3	Notropis	4	0	1-3	9 C
	Ericymba	6	0		
March 5	Etheostoma	13	0	1-3	9 C
	Lepomis	6	0		
	Notropis	15	0		
March 7	Pimephales	10	0	1-3	9 C
	Notropis	12	0		
	Hypentelium	5	0		
	Lepomis	6	0		
March 8	Etheostoma	8	0	1-3	9 C
	Notropis	10	0		
	Lepomis	5	0		
March 10	Notropis	10	0	1-3	9 C
	Lepomis	6	0		
	Etheostoma	5	0		
April 16	Notropis	9	0	1-3	16 C
	Lepomis	10	0		
TOTALS:		140	0		

A total of 547 fish were taken from Triplett Creek and examined for Ichthyophthirius. Fifty-nine of these were found to be infected with the parasite. Therefore, the fish from Triplett Creek showed an over-all 10.8 per cent incidence of infection with Ichthyophthirius.

NORTH FORK OF TRIPLETT CREEK

Station A.

One hundred sixteen fish from this station were examined for Ichthyophthirius; none were infected with the parasite.

Station B.

One hundred twenty-six fish from this station were examined for Ichthyophthirius; none were infected.

Station C.

One hundred forty-five fish taken from this station were examined; 17 were infected with Ichthyophthirius. Therefore, the fish examined showed an 11 per cent incidence of infection with the parasite. The fish were also parasitized by glochidia larvae, but the larvae were not so abundant on these fish as on those taken from Triplett Creek.

Station D.

One hundred thirty-two fish taken from this station were examined; none were infected with Ichthyophthirius.

Table 6. Collection data from North Fork of Triplett Creek Station A.

Date	Genus Name of Fish	Number Examined	Number Infected with "Ich"	Depth of Water (ft.)	Temp. of Water (C^{o})
April 2	Notropis	23	0	1-3	13 C
	Pimephales	16	0		
April 18	Notropis	15	0	1-3	18 C
	Semotilus	4	0		
	Pimephales	5	0		
April 19	Notropis	18	0	1-3	18 C
	Pimephales	6	0		
April 20	Notropis	23	0	1-3	18 C
	Semotilus	6	0		
TOTALS:		116	0		

Table 7. Collection data from North Fork of Triplett Creek Station B.

Date	Genus Name of Fish	Number Examined	Number Infected with "Ich"	Depth of Water (ft.)	Temp. of Water (C^{o})
April 5	Notropis	34	0	1-3	14 C
	Etheostoma	13	0		
	Lepomis	8	0		
April 19	Notropis	26	0	1-3	16 C
	Etheostoma	9	0		
April 21	Notropis	28	0	1-3	17 C
	Etheostoma	8	0		
TOTALS:		126	0		

Table 8. Collection data from North Fork of Triplett Creek Station C.

Date	Genus Name of Fish	Number Examined	Number Infected with "Ich"	Depth of Water (ft.)	Temp. of Water (C^{o})
April 1	Notropis	38	0	1-3	13 C
	Pimephales	10	0		
April 7	Notropis	26	3	1-3	14 C
	Pimephales	5	0		
April 16	Notropis	22	5	1-3	16 C
	Pimephales	15	3		
April 20	Notropis	25	6	1-3	17 C
	Pimephales	4	0		
TOTALS:		145	17		

Table 9. Collection data from North Fork of Triplett Creek Station D.

Date	Genus Name of Fish	Number Examined	Number Infected with "Ich"	Depth of Water (ft.)	Temp. of Water (C°)
April 3	Notropis	16	0	1-3	13 C
	Pimephales	12	0		
	Semotilus	4	0		
April 18	Notropis	23	0	1-3	17 C
	Pimephales	16	0		
	Semotilus	5	0		
April 20	Notropis	35	0	1-3	17 C
	Pimephales	15	0		
	Semotilus	6	0		
TOTALS:		132	0		

A total of 519 fish were examined from the North Fork of Triplett Creek. Seventeen of these were found to be infected with Ichthyophthirius. Therefore, the fish examined from the North Fork of Triplett Creek showed an over-all 3.3 per cent incidence of infection with the disease.

Table 10. Data concerning bait minnows purchased from Rowan County shops.

Date of Purchase	Place of Purchase	Bait Species	Number of Minnows Examined	Number Infected with "Ich"	Other Ecto-parasites Found
March 5	Owsley's Fishing Lake	Pimephales promelas (fathead minnow)	25	25	0
April 9	Caskey's Fishing Lake	Pimephales promelas (fathead minnow)	30	30	Gyrodactylus (numerous) Trichodina (numerous)
April 25	Owsley's Fishing Lake	Pimephales promelas (fathead minnow)	25	25	0
April 25	Caskey's Fishing Lake	Pimephales promelas (fathead minnow)	25	25	Gyrodactylus (numerous) Trichodina (numerous)
TOTALS:			105	105	

Fathead minnows obtained from Owsley's Fishing Lake were heavily infected with Ichthyophthirius. On the minnows, lesions were visible anterior to the dorsal fin and behind the gills. Lesions were also visible near the base of the caudal fin. According to the owner of the lake, these minnows were shipped from a hatchery in Minnesota. He reported that he drained the lake every November and that he did not have a high mortality rate among game fishes in the lake. Owsley's Lake is stocked primarily with bluegill, crappie, channel catfish, and rainbow trout. The owner also reported that his game fish are obtained from the same source as are his bait minnows.

Fathead minnows obtained from Caskey's Fishing Lake were heavily parasitized by Ichthyophthirius. The owner reported the loss of as many as fifty fish during the spring of 1970. An examination of the minnows sold as bait at Caskey's Fishing Lake revealed the presence of Trichodina (Plate 3), a serious ectoparasitic protozoan; and Gyrodactylus (Plate 4), a parasitic trematode. Caskey's Fishing Lake is not drained or chemically treated to combat the possible growth of parasitic populations.

ANALYSIS OF DATA

The fish from Triplett Creek examined for this study showed a 10.8 per cent incidence of infection with Ichthyophthirius as compared with a 3.3 per cent of incidence in those taken from the North Fork of Triplett. Of the fish examined from both streams, the author discovered that very few were heavily infected.

The potential danger of the presence of the parasite in the wild is illustrated by the data presented in this study. Although only a small fraction of the fish examined from the North Fork of Triplett were infected by the parasite, one-tenth of those taken from Triplett Creek were infected. The purpose of this study is not to explain conclusively the difference between the incidence of infection in these two streams, although several factors might be responsible. The author suggests four possible explanations for this difference:

1. Possibly the parasite has been present in Triplett Creek longer than in the North Fork of Triplett Creek.
2. The higher degree of pollution in Triplett Creek could provide a more suitable environment for the growth and development of Ichthyophthirius.
3. As the parasite must find a fish host to survive, the more rapidly flowing water of the North Fork of Triplett is less suitable to its life cycle than the slower flowing Triplett Creek.
4. Triplett Creek, which runs dry more frequently than does the North Fork of Triplett, forces fish into overcrowded still water pools which might allow the parasite to become more abundant.

The data obtained from the examination of bait minnows sold in Rowan County indicate that these heavily infected minnows are a threat to the wild fish population of the area. It was impossible for the author to determine how many infected bait minnows were used in the local streams as both bait shops are operated in conjunction with a fishing lake. However, it is conceivable that some of these minnows reached the local streams and increased the incidence of Ichthyophthirius, or perhaps even introduced the parasite into these streams.

In addition to the threat posed by the sale of bait minnows infected with Ichthyophthirius, there also exists the serious possibility of an increase in the incidence of Gyrodactylus and Trichodina in the wild fish population through the sale of bait minnows infected with these parasites.

SUMMARY

This study was initiated in order to determine the incidence of Ichthyophthirius multifiliis in fish from two freshwater streams and commercial bait shops of Rowan County, Kentucky.

Ichthyophthirius was found on fish from both Triplett Creek (10.8 per cent incidence of infection) and the North Fork of Triplett Creek (3.3 per cent incidence of infection). This study was not designed to determine the degree of fish mortality resulting from this parasite in nature, although such a study is needed. As W. E. Ricker (13) points out, the effect of most fish parasites in nature is not known and stands out as a major gap in establishing reliable perspectives in the field of fish mortalities.

Bait minnows examined were found to be heavily infected with Ichthyophthirius. The number of infected bait minnows sold for fishing in Triplett Creek and the North Fork of Triplett Creek was not determined.

It is the hope of the author that this study will stimulate interest in further research to determine the effect of the sale of infected bait minnows.

Plate 1. Photograph of the mature trophozoite of *Ichthyophthirius multifiliis*.

Plate 2. Photograph of the encysted stage of *Ichthyophthirius multifiliis*.

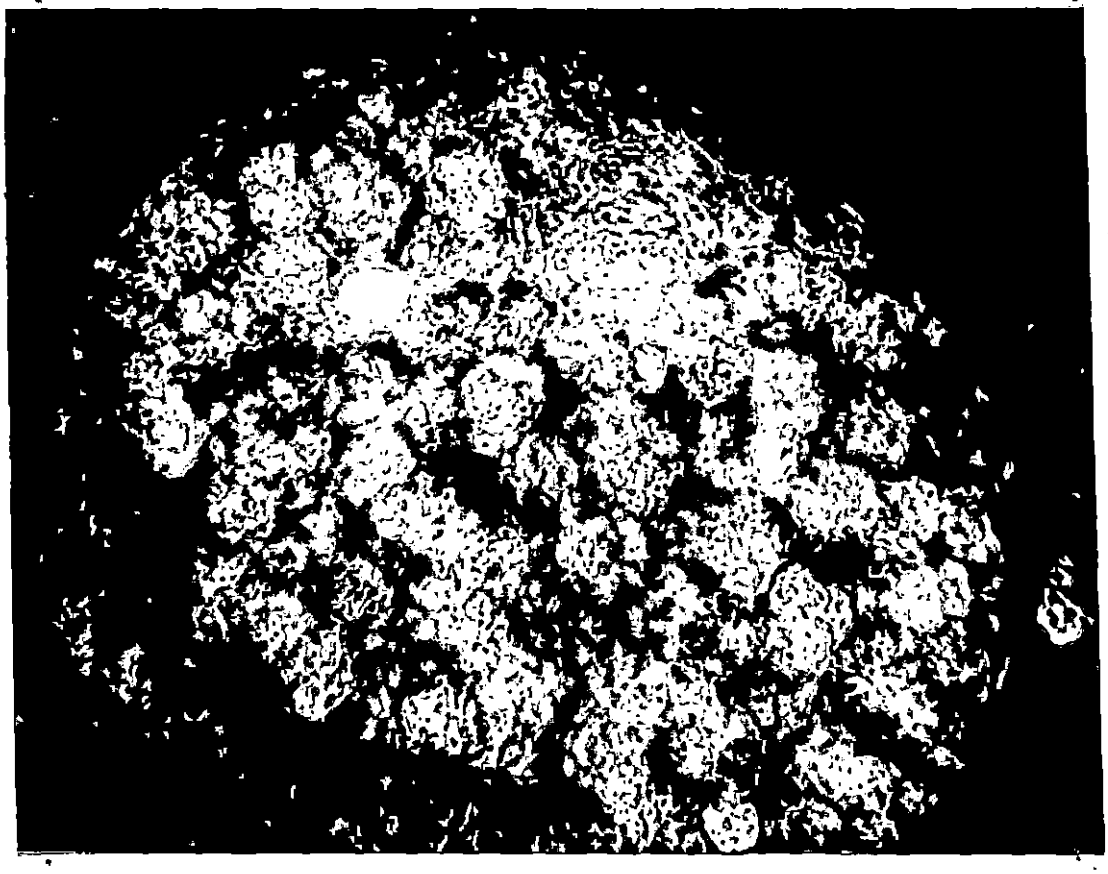
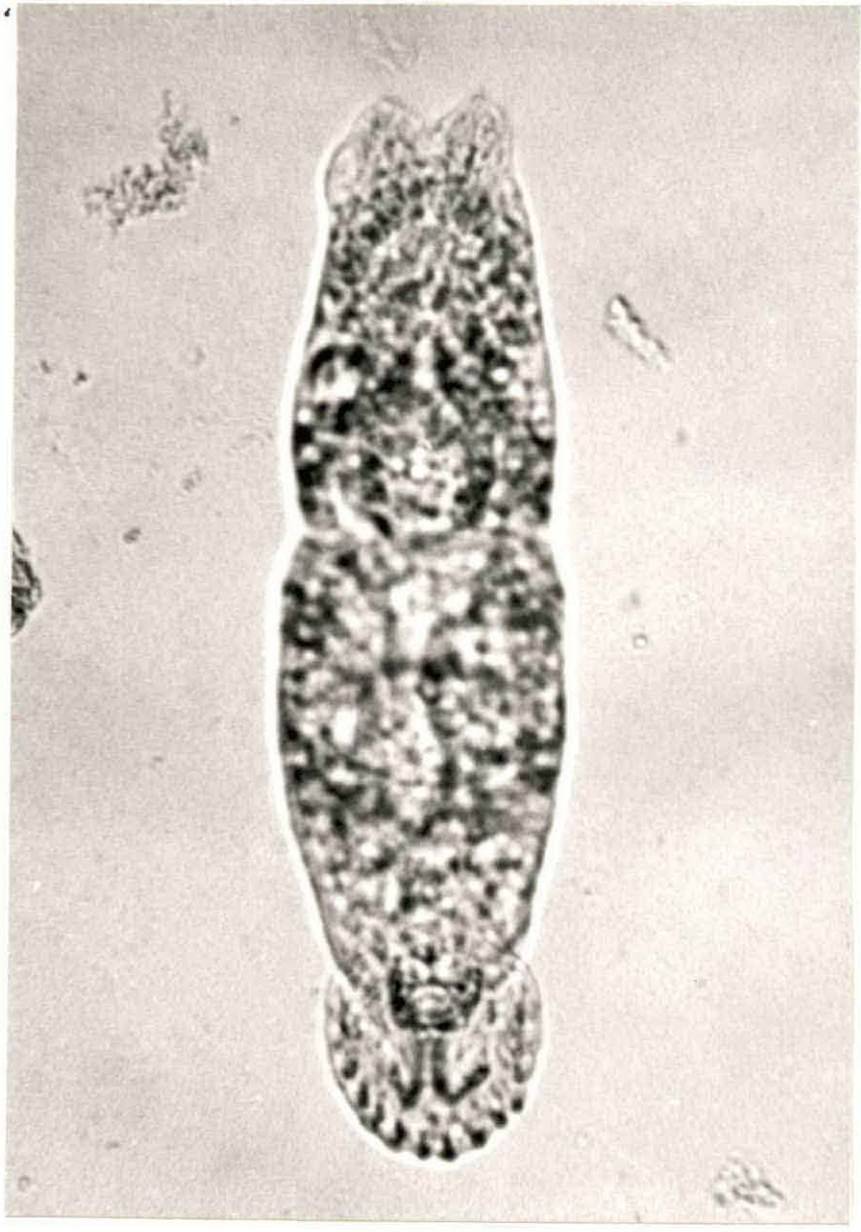


Plate 3. Photograph showing the aboral surface of Trichodina, an ectoparasitic protozoan.

Plate 4. Photograph of Gyrodactylus, an ectoparasitic trematode.



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